Chapter 4
Computer-Aided Algorithms for Underwater Image Enhancement and Object Detection

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ABSTRACT

The underwater world holds a wealth of secrets as it dominates three fourth of the earth surface. However, capturing underwater images with clear details is not an easy task. Light scattering, absorption, and limited visibility create a challenging environment for traditional cameras. The various phenomena that degrade underwater images and how it affect image clarity are examined. The image enhancement techniques, both traditional methods and cutting-edge deep learning approaches, which tackle issues like color correction, contrast enhancement, and haze removal, effectively restoring the true colors and details hidden beneath the water's surface are considered. Image enhancement plays a crucial role as a pre-processing step, paving the way for more accurate object detection. Various deep learning-based frameworks specifically designed to excel in these challenging conditions are explored in this chapter.

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1. INTRODUCTION

70% of the earth is filled with ocean. The world hidden below the ocean is a garden with mysteries and wonders. Capturing the beauty of this garden is challenging. On each attempt, the image captured is distorted because of light scattering resulting in an image with low contrast, color cast, and obscured details (Tarekegn et al., 2023). This chapter aims to describe computer-aided algorithms that can be applied to one underwater image covering 2 key areas namely, Underwater image enhancement and underwater object detection. Underwater image enhancement aims to recover the exact color and texture of the underwater world by incorporating color correction, gradient boosting, and image fusion algorithms (Hou et al., 2019). Underwater object detection pinpoints each object present within the image. These algorithms help to explore the marine environment, and coral reef structures, and monitor underwater resources (Li et al., 2023). Compared to traditional methods, the use of computer-aided algorithms provides promising results and ensures consistency. These methods aim at improving efficiency by automating image processing and object detection (Han et al., 2020). Several preprocessing methods like noise reduction, color correction, and white balance aid in achieving good outcomes.

Underwater images pose significant challenges when compared to an images taken on land. Such images are characterized by low contrast, blurred details, and color distortion. Contrast difference is caused mainly by the scattering and absorption of light in water. Enhancement of underwater images plays a crucial role in converting blurred images to a clear one. These methods help to remove the deep color tint using color correction and provide a natural image. Contrast enhancement methods can increase the sharpness and improve the edge details of the image making them more realistic (Woon, 2020). As a result, object detection becomes easier since the objects are distinct from their background, allowing researchers to locate

The visual capability of the human eye varies from person to person and those for an underwater image are too low. Sophisticated tools are needed in this field for better clarity and visualization of images. Based on this demand, research was carried out and algorithms were designed. These algorithms have helped marine biologists to conduct population surveys, species identification, and monitor the health and extent of coral reefs (Wang et al., 2023) (Gonzalez-Rivero et al., 2020). Underwater archeologists can use these tools for detecting submerged cultural heritage sites for detailed study (Kuzmin & Grekov, 2021). These algorithms can contribute to the search and rescue missions by locating objects and survivors with increased speed and accuracy. The bias and subjectivity that occur during manual processes can be eliminated with computer-aided algorithms, thereby generating more reliable results. Such algorithms can be easily deployed in real-time environments, helping autonomous underwater vehicles to make decisions in deep-sea projects.

Multi-Lingual Scene Text Detection Using One-Class Classifier

Anirban Mukhopadhyay, Sourav Kumar, Souvik Roy Chowdhury, Neelotpal Chakraborty, Ayatullah Faruk Mollah, Subhadip Basuand Ram Sarkar (2019). *International Journal of Computer Vision and Image Processing (pp. 48-65).*
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